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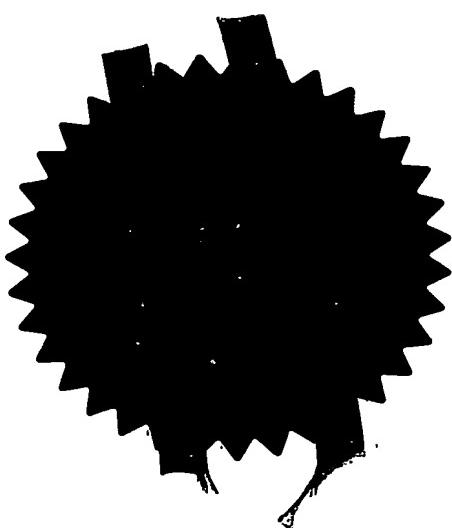
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PA 5074

0401274.6

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3. Full name, address and postcode of the or of  
each applicant (underline all surnames)PetroTecknik Limited  
PetroTechnik House  
Olympus Close  
Whitehouse Industrial Estate  
Ipswich  
Suffolk IP1 5LN

Patents ADP number (if you know it)

7323132003

If the applicant is a corporate body, give the  
country/state of its incorporation

United Kingdom

4. Title of the invention

CONNECTION BETWEEN A PIPE AND A WALL

5. Name of your agent (if you have one)

SOMMERVILLE &amp; RUSHTON

"Address for service" in the United Kingdom  
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AL1 3AW

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1511001

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Description	11
Claim(s)	0
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*Somersville & Lushton*

Date 21 January 2004

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Dr Ian H Coates  
01727 854215

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CONNECTION BETWEEN A PIPE AND A WALLField of the Invention

This invention relates to fittings for providing a seal between a wall and a pipe passing through an opening in the wall, to a method of providing such a seal, and to an assembly comprising the combination of a pipe, a wall and a fitting providing a seal between the two. The invention is particularly applicable to the provision of a seal between a pipe and a wall of a manhole chamber as found in a subterranean fuel tank or between a pipe and the wall of sump for a dispensing pump, for example in a petroleum forecourt installation, and in particular where the wall of a chamber or sump is made of glass reinforced plastic (GRP).

Background to the Invention

Subterranean piping systems of the type that are typically installed at service stations are generally utilized to communicate fuel or chemicals between an underground storage tank and an above ground dispensing station. The underground storage tanks and associated piping pose serious potential environmental and fire hazards as the chemicals contained therein could and have in the past leaked into the earth.

Oil companies have been under considerable pressure to ensure that environmental concerns are given priority in the planning and installation of petrol station infrastructures. This has not been without significant on-cost. One important advancement has been the use of pipeline systems constructed from plastics materials which have enabled the oil companies to install cost-effective environmentally acceptable alternatives to steel pipework systems which tend to corrode over time.

Moreover, over recent years there have been major developments in fuel technology which have culminated in commercially available alternative fuels containing additives which have replaced lead-based antiknock compounds. Research also continues to centre on reducing sulphur content and hazardous emissions from fuel. In order to eliminate lead and sulphur from fuels, exotic additives and octane enhancers such as MTBE (methyl tertiary butyl ether) have been developed which are based on complex organic or heavy metal organic additives.

The presence of these additives in fuel can give rise to major environmental issues. Some such issues are described in an article entitled "MBTE - How should

"Europe Respond", in Petroleum Review February 2000 pages 37-38. The entire text of this article is incorporated herein by reference by way of background information. The authors conclude that lead and some other metals are the most effective octane enhancers. However, lead is in the final stages of being phased out

5 because of environmental and health issues, and the most readily available alternative, MMT (methylcyclopentadienyl manganese tricarbonyl) is currently not widely accepted. The only other octane enhancers currently available are MTBE and other ethers such as ethyl tertiary butyl ether (ETBE) and tertiary amyl methyl ether (TAME), or alcohols such as ethanol. The ethers all tend to have similar  
10 properties and drawbacks. Ethanol is already used as a gasoline-blending component in parts of the United States where it is readily available, and in Brazil. It is an effective octane booster but has a number of drawbacks: it needs a "water-free" distribution system and is not without ground water issues. It is currently not recommended by the motor industry and is not cost-competitive.

15 The introduction of new fuel mixtures and esoteric additives has led oil companies to question whether existing pipeline systems can cope with the new fuels with regards to mechanical performance and permeability resistance. In some instances this will result in the pipework having to be replaced by pipework made from a more resistant material, with all the disruption that entails.

20 In petroleum forecourt installations, pipework running between dispensing pumps and a subterranean fuel storage tank passes into a manhole chamber which is situated directly above the manhole lid of the tank. The chamber is normally defined by an upstanding wall which, when viewed from above, can be of an octagonal, square, circular or rectangular shape, and which includes apertures through which respective pipes pass.

25 To overcome environmental concerns this pipework is now generally constructed from plastics materials and many current designs of forecourt installation utilise secondary containment. This involves containing each fuel supply pipeline in a respective secondary containment pipeline which is optionally sealed at its ends to the fuel supply pipeline. The secondary containment pipeline prevents leaks from the fuel supply pipeline from being discharged into the environment, and also can convey leaked petrol to a remote-sensing device. Typically, the pipes forming the secondary containment pipeline are initially separate from the fuel pipes and are sleeved over the latter as the fuel pipes are installed between the fuel storage tanks and dispensing pumps.

## 3.

A common material for the chamber to be constructed from is glass-reinforced plastic which involves moulding a resin or other polymeric material reinforced with fibres such as glass fibres.

It is desirable to provide a seal between each of the apertures in the 5 chamber wall and its respective pipe to avoid ingress of water into the manhole chamber. To that end, it is known to attach a fitting to a portion of the wall around the aperture and a rubber "boot" that sleeves over the pipe and is clamped to both the pipe and the fitting by, for example, jubilee (TM) clips. Some types of such fitting are bolted to the chamber wall, whilst other types of fitting provide inner and outer 10 parts between which the wall is sandwiched, the inner and outer parts being held together by a screw-threaded connector which extends through the aperture. These connectors often incorporate a rubber seal located between a part of the connector and the chamber wall.

Neither type of fitting provides a completely effective seal.

15 Over time, both types of seal can allow water to leak into the manhole chamber and to accumulate in a pool in the bottom of the chamber. This in turn makes the maintenance of the chamber bottom and tank entrance extremely difficult. In addition a defective seal can allow any petroleum fluid or vapours which find their way into the chamber to escape into the environment.

20 It would be preferable if such a fitting could be chemically bonded or electrofusion welded both to the pipe and to the chamber wall. One type of such fittings, manufactured from a plastics material capable of electrofusion to both the pipe and the chamber wall is known from GB2332255 (PetroTechnik Ltd). However, these fittings cannot be used when the chamber is constructed from GRP, a material 25 commonly used in construction of chambers and sumps for this application.

In summary therefore, in the event that pipework has to be replaced, or in new build situations, there is a requirement to seal pipework made from polyethylene, polypropylene, polyamide or the like to a GRP chamber wall. Accordingly it is an object of the present invention to provide a fitting for forming a 30 seal between pipework formed from a plastics materials and a GRP chamber which overcomes some or all of the above disadvantages.

#### Summary of the Invention

According to a first aspect of the present invention there is provided a fitting 35 for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting comprising:-

- (i) a first portion comprising a first tubular sleeve adapted to form a tight sliding fit with the outside of said pipe, the first portion further incorporating a radially extending first flange adapted to engage with the chamber wall around substantially the entire circumference of the first flange, the first portion further incorporating a second tubular portion extending away from the flange;
- (ii) a second portion incorporating a second radially extending flange adapted to engage with the chamber wall around substantially the entire circumference of the second flange;
- 10 (iii) securing means adapted to secure the first portion to the second portion. This arrangement enables the chamber wall to be clamped between the first and second flanges. GRP resin or other adhesive can be used on the face of one or both flanges in order to obtain a long-lasting waterproof seal between the flanges and the chamber wall(s).
- 15 Preferably the first tubular sleeve is formed from an electrofusible plastics material.
- In a particularly preferred embodiment the inner surface of the first tubular sleeve incorporates heating windings. It is thus possible to electrofuse the first tubular sleeve to the pipe passing through it in use to form a fluid-tight seal between the fitting and the pipe, which could be primary or secondary in construction.
- 20 Preferably the first tubular sleeve and the first flange are formed from different materials with a substantially fluid-tight joint there between. In this way, the first flange can be formed from a material that bonds readily to GRP whilst the first tubular sleeve can be formed from a plastics material which is electrofusible to the pipe. Such flange materials include metals such as stainless steel, coated steel, aluminium, coated aluminium or GRP itself or a plastics material that bonds satisfactorily to GRP.
- 25 Preferably the first flange and the second flange are formed from substantially the same material.
- 30 In a particularly preferred embodiment the securing means comprises complementary screw threaded regions on the first and second portions such that the two portions screw together, clamping the chamber wall(s) between the first and second flanges.
- 35 In a further preferred embodiment the first tubular sleeve is formed from polyethylene and the flanges are formed from stainless steel, coated steel or a polymer resistant to fuel.

It will be appreciated that the present invention also extends to encompass underground pipework systems including such fittings, and to garage forecourt systems incorporating them, methods for manufacturing such fittings and methods of forming a fluid-tight seal using such fittings.

5

Brief Description of the Drawings

The present invention will now be described by way of examples only with reference to the accompany drawings wherein:-

- Figure 1 is a partially cut-away side view of part of a petroleum forecourt installation  
10 which includes a tank having a manhole chamber, having a fitting in accordance with the invention;
- Figure 2 illustrates a cross-section through a fitting according to one embodiment of the invention with a first and second portion located on either side of double walled chamber;
- 15 Figure 3 illustrates an elevational view of a flange.

Description of the Preferred Embodiments

- The present embodiments represent currently the best ways known to the applicant of putting the invention into practice. But they are not the only ways in which 20 this can be achieved. They are illustrated, and they will now be described, by way of example only. By way of terminology used in this document the following definitions apply:-

- chamber - any receptacle designed to keep a fluid in or out. This includes, but is not limited to, manhole and sump chambers as described herein. It also includes tanks in general.  
energy transfer means - a generic term describing any form of energy source. Typically it takes the form of a resistance winding which heats up when an electrical current is passed through it. The term also encompasses other welding techniques including ultrasonic welding and induction welding.  
30 flange - any collar suitable for attaching a fitting to a chamber wall. In the examples given the surface of the flange which contacts the chamber wall is substantially planar. However, it will be understood that the flange must conform to the profile of the chamber wall around the pipe inlet opening. Thus the flange can adopt any suitable conformation to achieve the necessary contact with a flat or curved surface  
35 or even the corner of a container wall.

fluid – whilst the examples provided relate mainly to liquids, the term fluid refers to liquids, vapours and gases. For example, should a leak occur in a secondarily contained pipe in a garage forecourt installation then petrol or petrol vapour will collect in the manhole chamber. It is essential that this petrol vapour cannot escape through the wall of the chamber and into the surrounding ground.

5        pipe – the examples given herein are for a generally circular cross-sectioned single wall pipe. However, the invention also covers other cross-sections such as box sections, corrugated and the like and secondarily contained pipes of the "pipe-within-a-pipe" type. In this case the sealing member or boot for sealing the sleeve to the pipe will be rather more complex. However, such boots are well known in the art. The invention also encompasses pipes which are not circular in cross-section.

10        tubular sleeve – this term has a very broad meaning. It includes any tubular structure through which a pipe may pass. Although illustrated and described as substantially circular cylindrical in form, a sleeve according to this invention need not have a substantially circular cross-section and may conform to the profile of the pipe to be accommodated in it. Nor need the cross-section of the sleeve be uniform along its whole length, ie it need not be cylindrical.

15        Glass reinforced plastic (GRP) – The term GRP has a very broad meaning in this context. It is intended to encompass any fibre-reinforced plastic wherein a fibre of any type is used to strengthen a thermosetting resin or other plastics material.

20        The petroleum forecourt installation shown in Figure 1 comprises a pair of dispensing pumps 1 and 2 connected to a subterranean tank 3 through a pipeline 4. The pipeline 4 is formed from contiguously arranged sections of polyethylene pipe. The pipeline 4 extends from the pumps 1 and 2 into a manhole chamber 6 immediately above the tank 3. The chamber 6 is defined by a GRP member 8 having a sidewall 10 and a base 12.

25        Figure 1 shows two lines extending from the pipeline 4 into the tank 3. These lines relate to two alternative forms of fuel supply system and are both shown for the sake of completeness. In practice, only one of the lines would extend from the pipeline 4 into the manhole chamber 6. One of those lines is a suction line 14 which is used where the dispensing pumps 1 and 2 are fitted with suction pumps. The alternative line, reference 16, is a pressure line connected to the pipeline 4 via a pump 18 which is operable to propel fuel from the tank 3 to the pumps 1 and 2.

30        It can be seen from Figure 1 that the wall 10 has to be apertured in order to allow the pipeline 4 to pass into the chamber 6. In order to prevent water leaking from the surrounding ground (here denoted by reference numeral 20) into the

chamber 6 through the aperture, the pipe is sealed to the cylindrical wall 10 by means of a fitting 22 shown in more detail in Figures 2 to 3 inclusive. In the event of a spillage or a leak in a supply pipe the seal also prevents fuel from escaping into the environment.

5       Figure 2 illustrates the fitting 22 in greater detail. The purpose of this fitting is to form a strong, permanent, fluid-tight seal between the fitting and the chamber wall and between the fitting and the pipework system. In this embodiment, fitting 22 comprises two separate components, a first portion 24, consisting of a plastics fitting 31 and a metal flanged fitting 33, and a second component or portion 40.

10      Turning first to the portion 24, the plastics part of the fitting 31 consists of a generally tubular sleeve in which one end, a first end 32, has an internal diameter which is a tight sliding fit over the outside of a primary pipe 18. The opposite or second end 34 of the sleeve has an internal diameter which is a tight sliding fit over the outside of a secondary pipe 19. The plastics part of the fitting 31 is thus generally cylindrical in shape with non-uniform cross-section having a longitudinal axis through which a primary pipe may pass through the entire body of this part of the fitting. A secondary pipe may pass along this longitudinal axis from one end of the fitting only and only up to a certain point, where its passage is halted by a reduction in the internal diameter of the fitting.

15      20     The inner surface 44 of the component 31 accommodates energy transfer means, in this case windings 46 of electrical heating wire which lie close to, or at, the internal surface of the plastics component 31. These windings are electrically connected to terminal pins 47,48 projecting from the plastics component 31. The terminal pins 47,48 can be shrouded by hollow cylindrical plastic terminal shrouds 49,50 projecting from, and integral with, the plastic component 31. The methodology for laying heating wires of this type on the inner surface of a plastics fitting is well known.

25      30     To complete the construction of the first portion of the fitting a flanged metal fitting 33 is joined in a substantially fluid type manner during manufacture around the outer portion of that end of plastics fitting 31 which is adapted to accommodate the secondary pipe. This metal part of the fitting 33 comprises a generally tubular region 36 threaded on its external surface at the end of the fitting adapted to accommodate the secondary pipe. Extending radially outwards from the tubular region 36 is a flange 37, one surface of which is adapted to conform to and engage with the surface of the chamber wall. Thus the flange may be flat if the sides of the chamber are flat or curved if the chamber has curved walls.

The threaded structure described above acts as a securing means to secure the first and second portions of the fitting together and to clamp them firmly on either side of the chamber wall. A variety of securing means can be used such as bolts or other clamping means.

5 In this example the metal component is crimped or internally swaged over the plastics component, which is held in place between shoulder 37 and crimp 38.

In order to improve the fluid-tight nature of the seal between these two components, a series of grooves, slots or ridges (not shown) can be formed in the region where the two sleeves overlap. When the joint is formed, plastics material 10 fills these grooves, preventing the two components from separating in use.

15 Optionally, the seal between the two sleeves can be further improved by incorporating a sealing means such as an O-ring (not shown). The O-ring nests into a annular channel around the circumference of one or other of the sleeves. It will be appreciated that the O-ring seal can be positioned during assembly on either the first or second sleeve. For ease of construction it would normally be positioned on the outer surface of the plastics tubular sleeve, towards the end of that sleeve which is located within the body of the fitting itself.

It will be appreciated that the O-ring could also be positioned in the end face 39 of the first sleeve, engaging with a shoulder 35 in the second sleeve.

20 Because the O-ring is internal to the fitting, and sealed within, it is expected to have a very long life, at least the life of the fitting.

25 The second portion of the fitting 40 comprises a generally tubular component 42 with internal threads 43. The diameter, size, shape, depth and pitch of threads of this component are designed to allow this second portion to thread onto and over the corresponding end of the metal part of the first component. This second portion also has a radially extending flange 45.

30 The flange 45 can be seen in more detail in Figure 3. The face of the flange is perforated by a series of apertures. Apertures or indentations 60 are provided in order to engage the flange with a tool during assembly to turn it and tighten it against the chamber wall. Cut outs or slots are provided to allow resin to pass through the body of the flange to increase the strength of bond between the flange and the wall (see below).

35 Various other shapes and devices can be used to provide a turning purchase on the flanges. Opposing sides of one or both portions could contain flats such that a spanner, wrench or special tool could be used. Alternatively the flange

could incorporate protrusions or cut outs which could be used to obtain the necessary purchase.

In use, the first portion 24 of the fitting is passed through a pre-drilled hole in the chamber wall, usually from the inside of the chamber, until the flange engages flat against the chamber wall. Before doing this however, GRP resin, glass fibre mat or other adhesive is applied to the face of the flange or to the chamber wall around the aperture. Similar adhesive is applied to the flange/chamber wall on the outside of the chamber. Alternatively the flange(s) may be clamped firmly against the chamber wall and resin or other suitable adhesive applied over substantially the whole exposed surface of the flange and the surrounding area. This will also result in a strong fluid-tight seal.

In a further alternative resin/adhesive may be applied to both faces of the flange, both between the flange and the chamber wall and over the external, exposed face of the flange.

The second portion of the fitting 26 is then screwed onto the threaded portion of the first fitting which extends through the chamber wall, and the two portions of the fitting are tightened onto the chamber walls to form a fluid-tight seal once the adhesive has set.

A primary and secondary pipe are then passed through the fitting as shown in Figure 2 and an electric current passed through windings 46 to seal both primary and secondary pipes to the fitting.

It will be readily appreciated that the plastics part of this type of fitting can be formed from a wide variety of plastics materials as selected by the materials specialist. Preferably the plastic component is formed from one or more plastics materials selected from the group comprising:-

polyethylene;

polypropylene;

polyvinyl chloride;

polybutylene

polyurethanes;

polyamides, including polyamides 6, 6.6, 6.10, 6.12, 11 and 12;

polyethylene terephthalate;

polybutylene terephthalate;

polyphenylene sulphide;

polyoxymethylene (acetal);

ethylene/vinyl alcohol copolymers;

polyvinylidene fluoride (PVDF) and copolymers;  
polyvinyl fluoride (PVF);  
tetrafluoroethylene-ethylene copolymer (ETFE);  
tetrafluoroethylene-hexafluoroethylene copolymers (FEP)  
5 ethylene tetrafluoroethylene hexafluoropropylene terpolymers (EFEP)  
terpolymers of tetrafluoroethylene, hexafluoropropylene and vinylidene  
fluoride (THV);  
polyhexafluoropropylene;  
10 polytetrafluoroethylene (PTFE);  
polychlorotrifluoroethylene;  
polychlorotrifluoroethylene (PCTFE);  
fluorinated polyethylene;  
fluorinated polypropylene;  
and blends and co-polymers thereof.

15 This selection is not intended to be limiting but rather demonstrates the flexibility and breadth of the invention. The plastics material which is most compatible to the pipe to which it will be joined and with the lowest permeability to the fluid in question will usually be chosen by the materials specialist. Furthermore, it is known to use blends of two or more polymers and this invention extends to 20 cover known and yet to be developed blends of plastics material.

Alternatively the plastic component can be formed from 2 or more layers including but not limited to a barrier layer or layers. This form of construction may require the use of one or more tie or adhesive layer between adjacent layers. Alternatively direct bonding may be used to adhere the individual layers, preferably 25 during melt processing, whereby one or both of the materials have been chemically modified to bond to the other. Additionally, the plastics material or barrier layer(s) may incorporate a dispersed electrically conductive material producing a maximum surface resistivity of  $10^6 \Omega/\text{sq}$ . This avoids build up of potentially dangerous static electrical charges. A surface resistivity in the range of  $10^2$  to  $10^6 \Omega/\text{sq}$  is preferred, 30 with a more preferred surface resistivity in the range  $10^2$  to  $10^6 \Omega/\text{sq}$ . Examples of possible barrier layers include:

35 polyvinylidene fluoride (PVDF) and copolymers;  
polyvinyl fluoride (PVF);  
tetrafluoroethylene-ethylene copolymer (ETFE);  
tetrafluoroethylene-hexafluoroethylene copolymers (FEP)  
ethylene tetrafluoroethylene hexafluoropropylene terpolymers (EFEP)

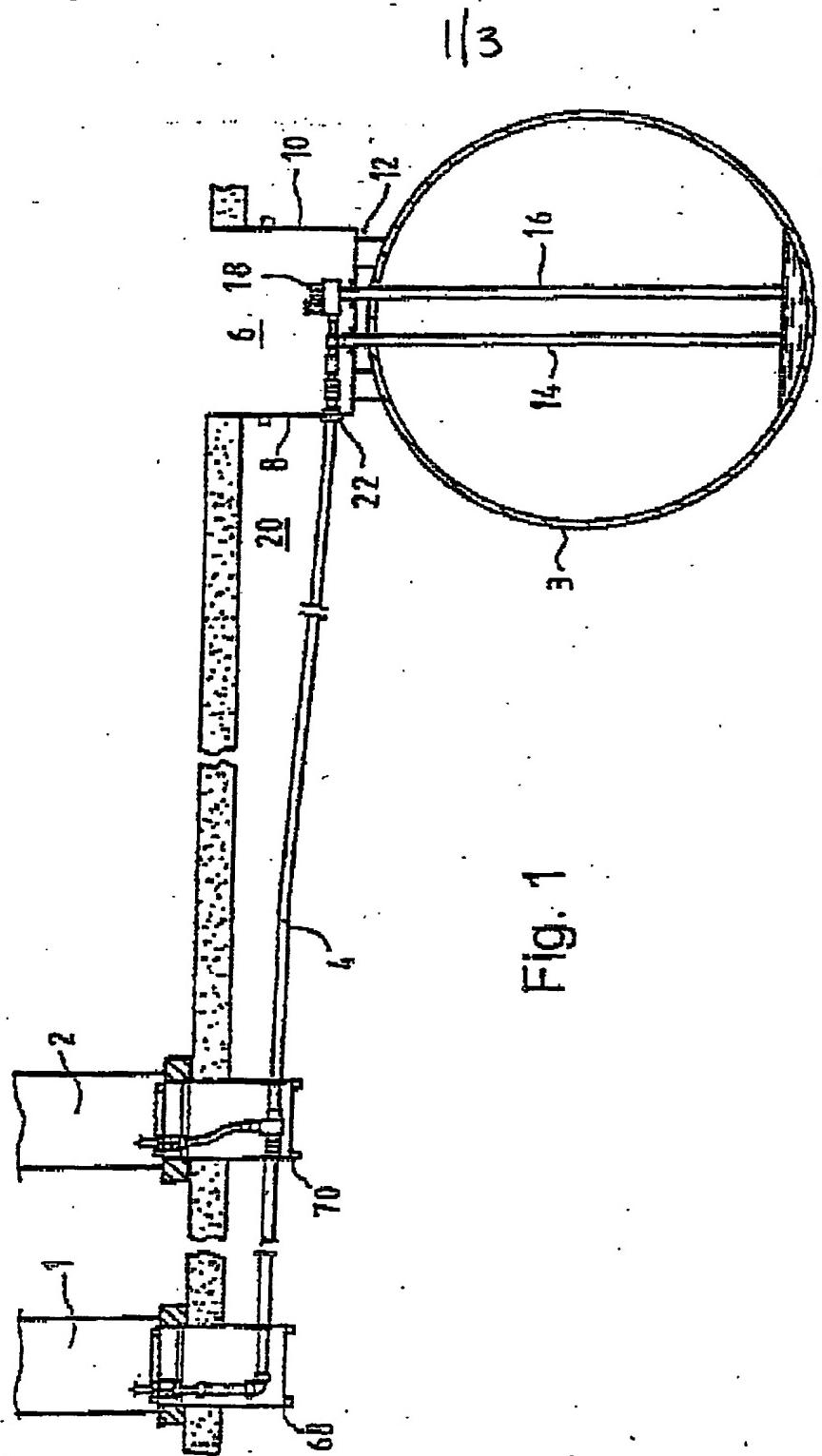
terpolymers of tetrafluoroethylene, hexafluoropropylene and  
vinylidene fluoride (THV);  
polyhexafluoropropylene;  
polytetrafluoroethylene (PTFE);  
5 polychlorotrifluoroethylene;  
polychlorotrifluoroethylene (PCTFE);  
fluorinated polyethylene;  
fluorinated polypropylene,

and blends and co-polymers thereof.

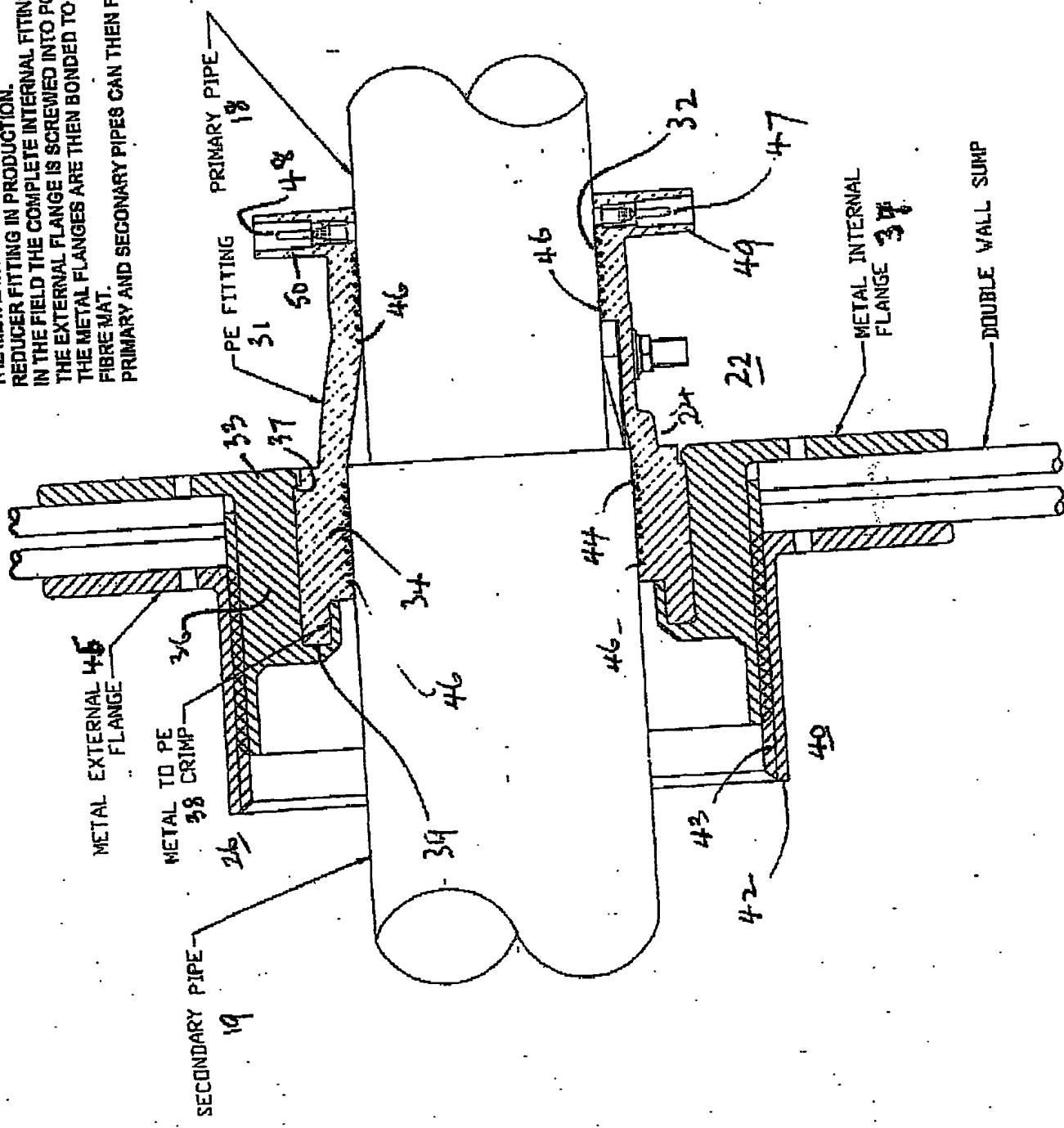
10 Once again, this selection is not intended to be limiting, but rather demonstrates the wide range of polymers that may be used for this purpose. It is intended that this disclosure encompasses all known fluoropolymers providing a suitable barrier function and those yet to be discovered.

15 Fittings according to the present invention can be used equally well on single or double walled chambers. Because a seal is formed on both sides of the wall, the integrity of the interstitial space between the chamber walls is maintained and can be monitored. They can be used equally well to form a seal between a pipe and the wall of a sump, such as sums 68 and 70 in Figure 1.

20 For the purposes of this description the term pipe generally refers to a circular cross-sectioned pipe. However, this invention also covers pipes having other cross- sections such as box sections, corrugated and the like and also single walled or secondarily contained pipes.



THE METAL INTERNAL TERMINATION FITTING IS INTERNALLY CRIMPED TO THE PE REDUCER FITTING IN PRODUCTION.  
 IN THE FIELD THE COMPLETE INTERNAL FITTING IS PASSED THROUGH THE HOLE AND THE EXTERNAL FLANGE IS SCREWED INTO POSITION TO SECURE THE FITTING.  
 THE METAL FLANGES ARE THEN BONDED TO THE BUMP WALL USING RESIN & GLASS FIBRE MAT.  
 PRIMARY AND SECONDARY PIPEES CAN THEN FUSED BY ELECTROFUSION.



3/3

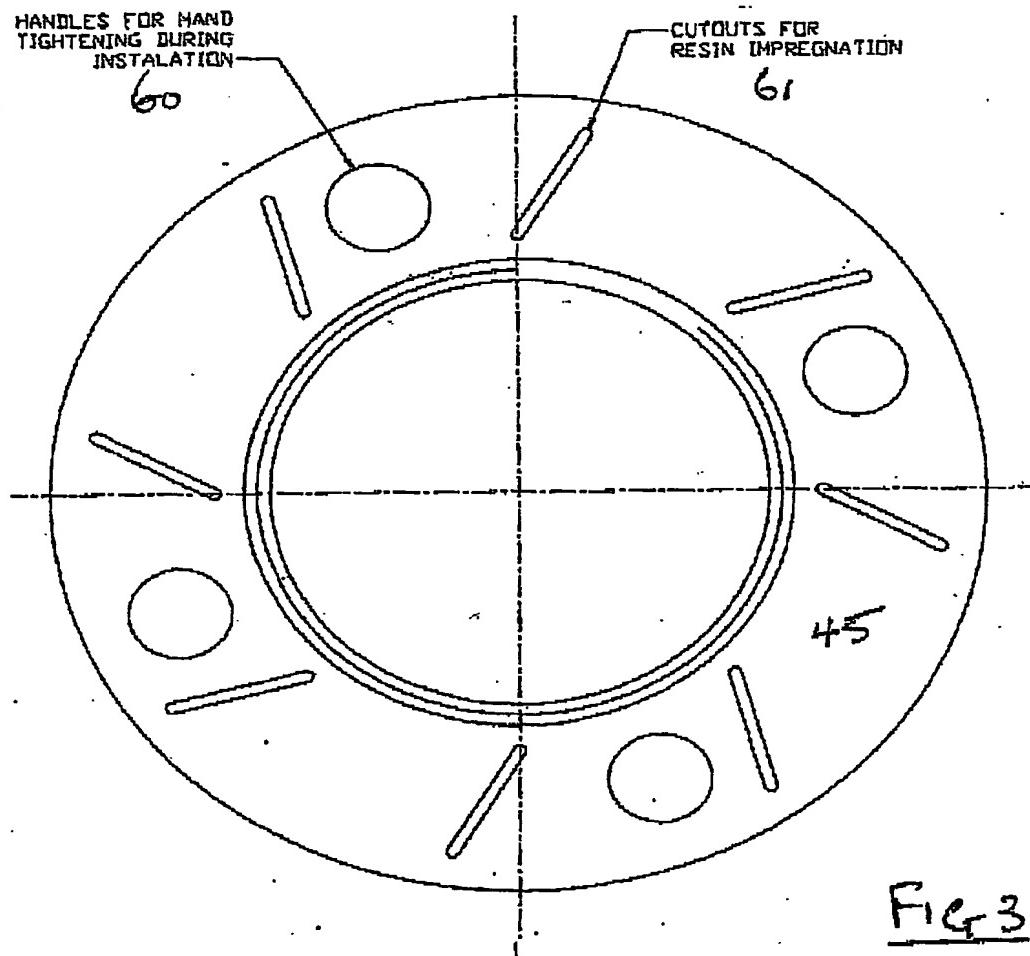


Fig 3

SCRAP VIEW SHOWING EXTERNAL FLANGE DETAILS

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